Experimental verification of anaerobic fermentation of potato processing agro-industrial waste products

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Introduction & Methods

- Agricultural-based industries produce a vastly amount of waste each year.
- This study – Experimental verification of anaerobic fermentation of waste products from potato processing
- Substrates* – native settled starch (1), starch fraction removed after coagulation with aluminium sulphate (2) and potato peels – analysis: TS, ash content, VS, pH and CHNS elemental analysis
- Biogas composition (GC), thoretical (Buswell equation) vs experimental yield in LAB and PILOT scale

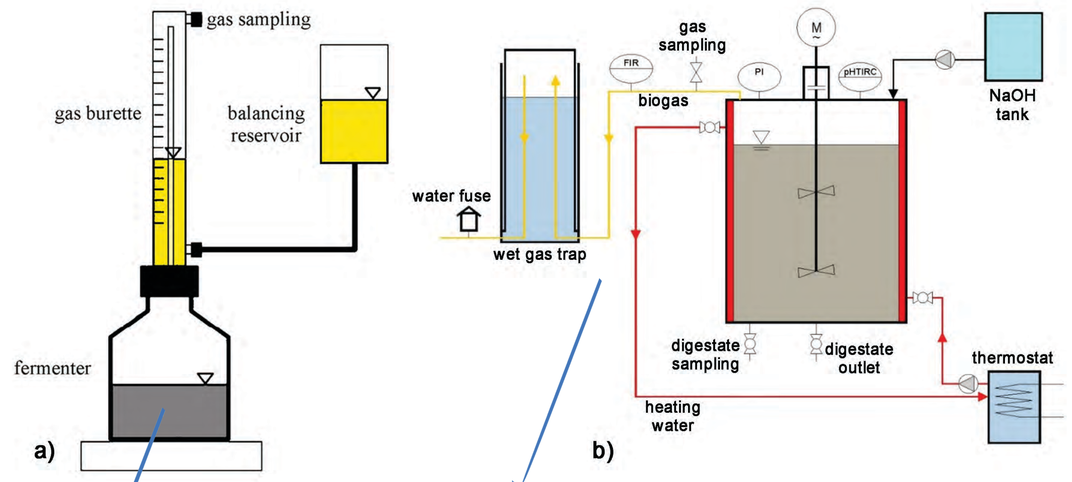
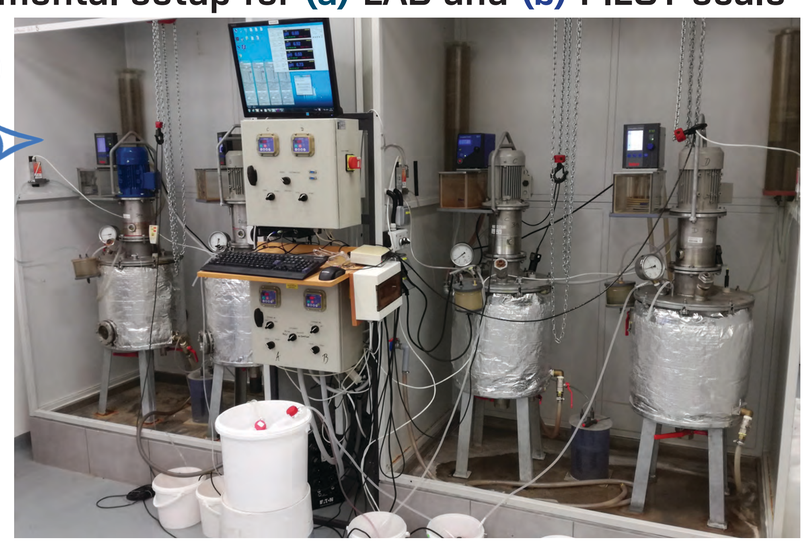


Fig. 1 Experimental setup for (a) LAB and (b) PILOT scale

(a)

(b)



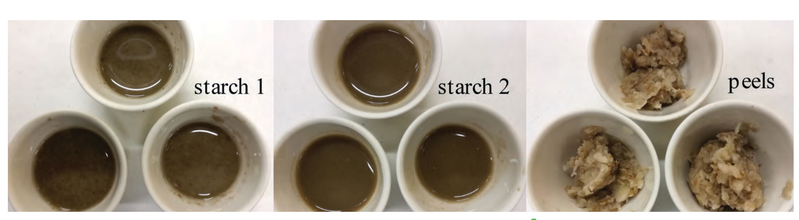


Fig. 2 Tested substrates*

Results & Discussion

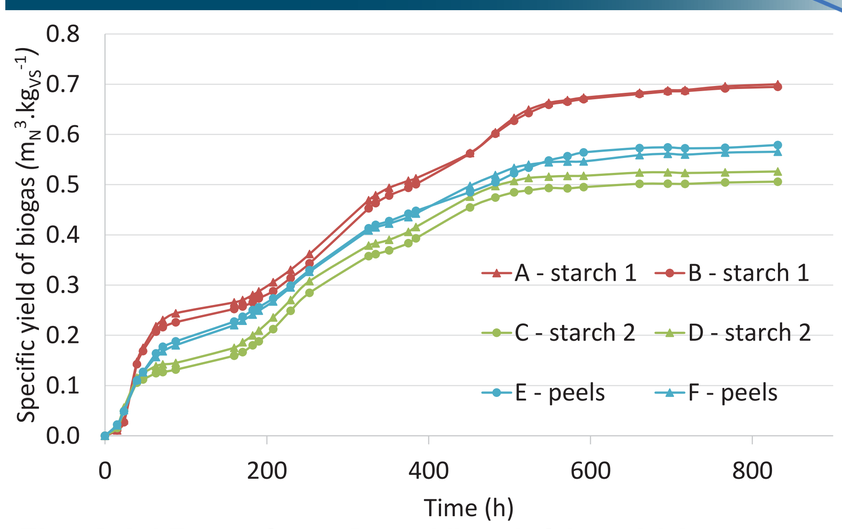


Fig. 3 LAB scale – Specific yields of biogas

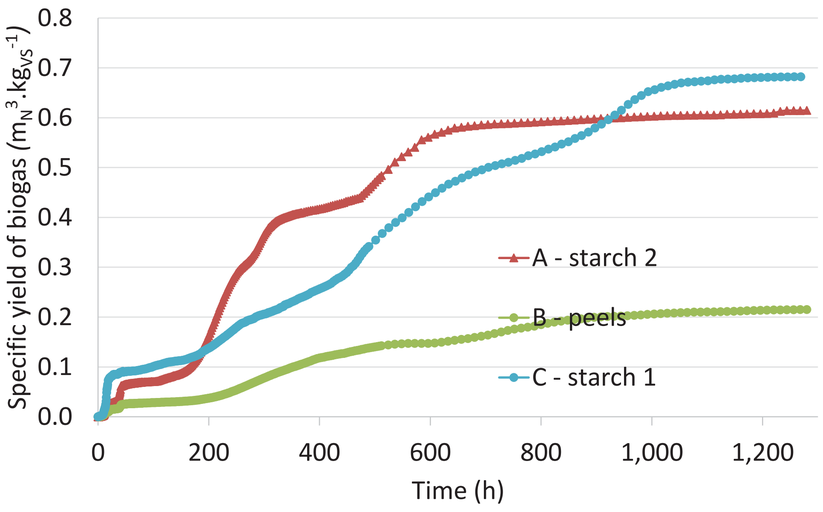


Fig. 4 PILOT scale – Specific yields of biogas

Tab. 1 LAB scale – biogas and CH_4 yields

substrate	*LAB scale*								
	biogas yield			CH_4 concentration			CH_4 yield		
	theoret.	experim.	yield	theoret.	experim.*		theoret.	experim.	yield
(-)	($m_N^3.kg_{VS}^{-1}$)		(%)	(% vol.)			($m_N^3.kg_{VS}^{-1}$)		(%)
starch 1	1.057	**0.697**	66.0	65.1	**58.4**		0.461	**0.407**	88.3
starch 2	0.536	**0.516**	96.4	75.7	**57.8**		0.457	**0.299**	65.3
peels	1.144	**0.572**	50.0	73.2	**53.1**		0.614	**0.304**	49.5

Tab. 2 and 3 LAB scale – composition of biogas

experiment	*LAB scale (average values)*			
fermenter	A+B	C+D	E+F	G+H
substrate	starch 1	starch 2	peels	sludge
CO_2 (% vol.)	28.91	24.13	27.01	12.24
O_2 (% vol.)	0.19	0.20	0.20	0.47
N_2 (% vol.)	10.04	13.26	13.20	55.67
CH_4 (% vol.)	58.38	57.84	53.14	32.50
SUM (% vol.)	97.52	95.44	93.55	100.87

experiment	*LAB scale (without inert gas)*			
fermenter	A+B	C+D	E+F	G+H
substrate	starch 1	starch 2	peels	sludge
CO_2 (% vol.)	33.12	29.44	33.70	27.36
CH_4 (% vol.)	66.88	70.56	66.30	72.64
SUM (% vol.)	100.00	100.00	100.00	100.00

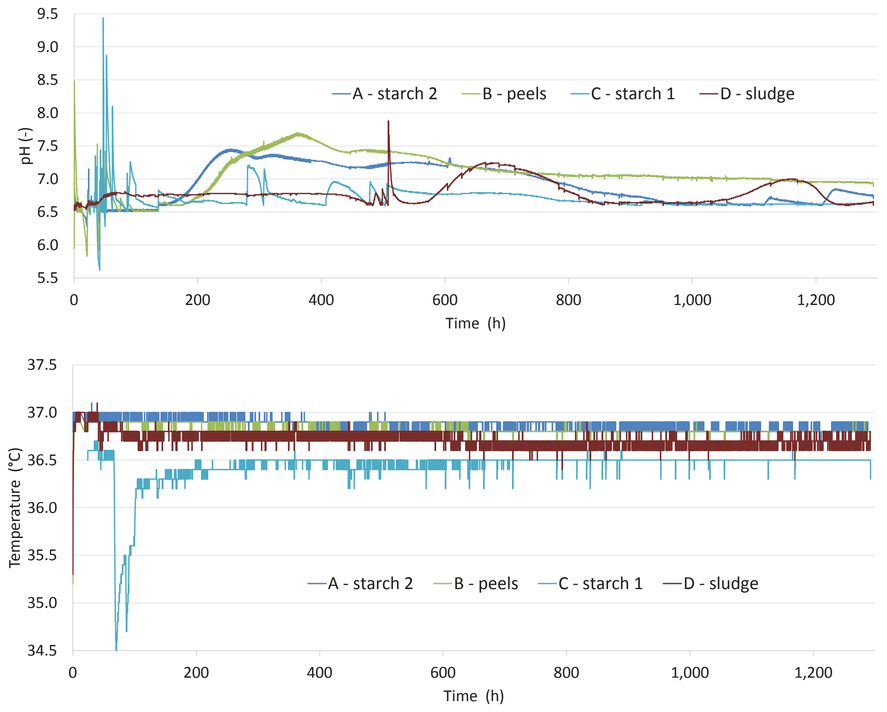


Fig. 5 PILOT scale – ph/time and T/time

Tab. 4 PILOT scale – biogas and CH_4 yields

substrate	*PILOT scale*				
	biogas yield			CH_4 concentration	
	theoret.	experim.	yield	theoret.	experim.**
(-)	($m_N^3.kg_{VS}^{-1}$)		(%)	(% vol.)	
starch 1	1.057	**0.682**	64.5	65.1	78.9
starch 2	0.536	**0.579**	108.0	75.7	77.6
peels	1.144	0.191*	16.7	73.2	77.1

Tab. 5 Biogas and CH_4 yields - average values from LAB and PILOT cultivations

substrate	biogas production ($m_N^3.kg_{VS}^{-1}$)	CH_4 production ($m_N^3.kg_{VS}^{-1}$)
starch 1	**0.690**	**0.407**
starch 2	**0.547**	**0.299**
peels	**0.572**	**0.304**

Conclusions

- At the lab and pilot scale, the production of biogas and methane from 3 potato processing waste substrates was verified.
- It was assumed that all tested substrates provide enough biogas and methane to be of interest to the biogas plants.
- The level of organic dry matter removal is also high and ranges from 75 to 90 %.
- The potential of substrates for biogas and CH4 production decreases in the following order: native starch, flocculated starch, peels.
- Starches are well decomposable for microorganisms and can cause slowdown or even fermentation collapse in case of too high dosing.
- As a suitable dosing of tested substrates 0.35 kgVS/m³/day was estimated to be optimal (calculated with 30-days fermentation).

Acknowledgements

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